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### What's natural: a species history of Scotland in the last 10,000 years

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#### ABSTRACT

The question of what is natural is considered, and a mismatch is pointed out between the view that man is part of nature and the view that 'natural' means all living things apart from man. The history of man's ability to change the environment of Scotland is briefly outlined, with reference to climate history and some recent modifications to the view that man reduced Scotland to a 'wet desert'. The distinction between native and alien is traced to the Victorians, but it did not become set in stone until after the Second World War. The history of mammals is discussed with particular reference to island races, and to the varied history of the red squirrel and attitudes towards it. In the case of birds, some that are not alien can still be almost entirely dependent on man. Plants are divided into archaeophytes and neophytes depending whether or not they arrived before 1500, and some archaeophytes are now protected. There is brief mention of insects, fungi, the carriers of plant diseases and aquatic organisms. Globalisation has been the greatest carrier of alien species, but only a few have proved invasive.

#### INTRODUCTION

In 2012, Prince Charles wrote a foreword to Plantlife's booklet, *Our Vanishing Flora*, deploring the destruction of native biodiversity. He said "progress has completely disconnected us from the natural world, so that we no longer appreciate that we are, in fact, an integral part of Nature; we are Nature".

He was of course quite right. We are not above Nature or separate from Nature, we are subject to evolution in the same way as a toad or a fungus, a twig in the tree of life not intrinsically different, better or higher than any other. Darwin established that. True, we are the only species that has evolved to be able to alter even the physical properties of the earth's atmosphere. But like every other species we are still dependent for survival on the energy of the sun, and the integrity of global ecosystem

services. We speak of our control over nature, but that is an oxymoron; nature has never ceased for one moment to control us.

But in common parlance most of us, even scientists, continue to speak as if nature was something apart from us: we talk of the 'natural environment' in distinction from the 'built environment', of Scottish Natural Heritage as opposed to Historic Scotland, of the 'natural world', as the world apart from humanity. I shall do the same in the rest of this talk, but this use of nature and natural to mean only the non-human is a matter of subjective convenience, not of scientific reality.

The whole discussion of re-wilding, and of favouring native above alien species, depends upon by this definition of nature as beyond or before the human. Re-wilding and re-introduction, therefore, have more to do with history than science, if we define the wild as being in the state of nature, or what some term (following George Peterken, 1996) the 'original natural'. Re-wilders look to discover the condition of the environment before man acquired the power to alter it. They make a romantic and daring attempt to return to the Garden of Eden, using an assumed historical knowledge as a pass to re-enter it. They will use ecology once they get in, but they need history to tell them how to recognise the Garden, and to tell them what is native to the Garden and what is not.

The power of man to alter the environment came gradually and incompletely. In Scotland, the earliest traces of humanity yet found are those of hunter-gatherers at Cramond on the edge of Edinburgh, dated to about 10,000 years ago, within a millennium of the end of the last ice age. It used to be assumed that Mesolithic people were too sparsely distributed and ignorant to be able to alter their surroundings, but many archaeologists now think that they set fires big enough to make substantial woodland clearings, in order to attract grazing prey. Then came farmers: about 4000 years later there is evidence of Neolithic communities, the

first identified site being at Balbridie in Aberdeenshire. They practiced pastoralism. Then there followed the use of hoes for agriculture and of axes to clear woodland, and thereafter our ability to change the environment is not in question.

But even if we tried to recreate the environment of Mesolithic Scotland today, in one important respect it would not be authentic. The Scottish climate of the Mesolithic (and indeed the Neolithic) was variable, but generally more benign than it is today, warmer and less wet in summer, more like that of the south-west of modern France. No amount of search for the original-natural can recreate that situation now, though within a few decades when the effects of global warming kick in, it might become possible.

However, at the start of the Bronze Age about 4000 years ago, there was an abrupt change in the climatic systems, inaugurating the modern age of rising winds and rain. This had a dire natural effect on the existing vegetation and ecosystems of Scotland. So should we be looking to the Bronze Age as the model for an authentically re-wilded Scotland? From this point the formation accelerates of most of the raised and blanket bogs of Scotland, associated with the natural decline of forest. The latest findings of palaeoecology (Tipping, 2008) indicate that this was an entirely natural phenomenon, not in any sense anthropogenic, and you might argue that at this point nature in Scotland reaches its modern form.

Some would go further. James Fenton, whose work is not yet widely accepted or even discussed (being available mainly on-line) more contentiously argues that not only the bogs but also the open spaces of the heather moors are entirely natural, as in this new climatic regime the ground became incapable of supporting extensive tree cover: red deer would graze down regeneration, as it was not sufficiently protected in winter by snows as it was in Scandinavia (Fenton 2011) In his view, the open spaces of Scotland are not the anthropogenic wet desert of Fraser Darling (1956), created by overgrazing and human neglect, but the finest heritage of natural open space in Europe. It is threatened (he argues) by tree planting, not only of alien conifers, but also of Caledonian pine and other native woodland promoted by charities like Trees for Life, the Woodland Trust and the RSPB. Trees are, he would argue, inappropriate in most of the places where they are being encouraged because they threaten a natural, albeit Bronze Age and not Mesolithic, eco-system of open space.

This is the context of the species history of Scotland in the last 10,000 years. What about natives and aliens? The distinction between the two emerged only gradually, initiated by Victorian botanists in

the 1830s, by Darwin's mentor, John Stevens Henslow, and by the great father of British botanical geography, Hewett Cottrell Watson (Chew, 2011). As national and county floras began to be compiled, botanists wished to distinguish between a plant which was immemorially present and native in the wild, and one which had escaped from local gardens or had enjoyed an assisted passage in a bale of Australian wool or a consignment of American grain. The latter, the alien, was considered as less natural and authentic, and marked on their lists with an asterisk or a dagger, as it still is.

However, definitions of native and alien did not become set in stone until after the Second World War, in the context of the rise of genetics, and growing concern about the damage done by some releases of non-native species. In many cases, the question of what is native and what is alien is riddled with paradox and puzzle. (See Usher, 2000, Webb, 1985)

Broadly, for us, the native is the 'natural' inhabitant of a 'natural' Scotland. The last ice age left Scotland a tabula rasa, plants and animals from earlier interglacials having been removed by the extreme cold. Anything which came here since that time unaided by people is defined as natural. Anything that came through human agency is defined as an alien. It does not matter when they came, except that species that existed here in the interglacial before the last ice-age, but did not arrive unaided since the last one (like the Norway spruce) are classified as aliens. However, if a species has been made extinct through human agency at any point in time in the last 10,000 years, it is entitled to come back as a native, even if its return will need (as it often does) the most extensive and expensive human aid (and today also Government approval) to become re-established; capercaillie, beavers, sea eagles and red kites are the relevant cases in point in Scotland.

The alien, by contrast, is defined as a taxon with no earlier natural residency in Scotland, but which arrived with human assistance. Aliens are not considered natural in Scotland even if they arrived centuries ago, like rabbits, pheasants and sycamores, so are not normally afforded any legal protection as part of the natural heritage, though there are exceptions. For instance, the little owl is protected because the relevant mid-twentieth century legislation predates the highest modern anxiety about alien species, and in the interwar years scientists had spent a lot of effort demonstrating that it was harmless to game.

## DISCUSSION

Unless you have wings or can float in the air like dust, there is certainly a large element of luck as to whether you are a native or not. Mammals were not



very lucky. Those which failed to make it to Britain before the final drowning of the land bridge over the North Sea about 8500 years ago, forever lost the opportunity to establish native status. So we have as native, red deer and roe deer but not fallow deer or sika deer, native otter and wild cat, but no native rats, native wood mice but no house mice and no native rabbits or brown hares. The house mouse came before the Romans (to Britain at least) the black rat came first with the Romans to England, with no proof of them in Scotland before the thirteenth century, and the brown rat (which has almost completely displaced the black) only in the eighteenth century. The rabbit came with the Normans to England, and specifically into Scotland probably with Normanised English monks. The oldest known colony is from the fourteenth century, on the Isle of May. The native beasts of post-ice-age Scotland initially included a whole tranche of splendid predators (brown bear, wolf, lynx) and large ungulates (auroch, wild cattle, wild boar and elk), as well as the beaver. The elk and the auroch perished before Roman times, the brown bear, the lynx, true wild cattle and the wild boar, probably in the in the middle ages, the beaver before 1600, and the wolf by 1700. In the general mayhem of the great game preserving age of the Victorians, the polecat also perished, while wild cat and pine marten were forced back to the remoter fastnesses of the Highlands.

Small rodents are especially interesting on the Scottish islands. The distinctive St Kilda house mouse is now extinct, barely surviving a year following the retreat of the human population to the mainland in 1930: it was akin to the house mouse of Norway, suggesting Viking involvement in its introduction (so it was an alien), and it had been there long enough to develop into a recognised subspecies about twice the size of a mainland house mouse (Love, 2009, Yalden 1999). The fact that it became extinct immediately on human withdrawal, seems proof of continuous human occupation of Hirta at least since Viking times, which some have occasionally questioned.

The other particularly interesting island rodent is the Orkney vole, a subspecies of the common vole of Europe and not related to the field vole that occupies the rest of the British Isles: recently it has been shown to have the closest relationship with Spanish common voles. As it is an animal found in Neolithic graves, and may be regarded as probably a totem animal or at least a pet, it is fair to assume it came over with the earliest settlers (Yalden 1999, also Yalden in O'Connor and Sykes, 2010). Like the St Kilda house mouse it is technically an alien species yet has developed into a native subspecies.

Squirrels are a special and fascinating case, worth lingering over. The red squirrel today is an

endangered native species that all but died out once before. In a process of protracted decline, it had evidently gone from Sutherland even before 1630, from Dumbarton, Moray, Ross and Cromarty by 1800, and from Angus, Aberdeenshire and Argyll before 1850, some apparently hanging on in Speyside. It is very unclear why the red squirrel declined like this. The conventional explanation of habitat loss seems most unlikely, as there were still plenty of woods left in the nineteenth century in all the counties listed. Disease is a more probable explanation, as we know that some form of squirrel plague devastated many English populations at this time. This indeed led to the introduction of grey squirrels to the London area by philanthropic Americans, who responded to the English wish not to be left without some sort of squirrel to amuse them.

The red squirrel might also have gone from Scotland at this point, had there not been deliberate reintroductions by landed gentlemen who also missed them, the most significant being those of the Duke of Buccleuch into his estate at Dalkeith from England in 1772 and of the Duke of Atholl into Dunkeld apparently from Scandinavia in 1790, followed by a natural reinvasion of the south-west from England, and further reintroductions to estates in the Highlands and elsewhere. What came in was probably not genetically identical with what had been lost. It is said that the descendents of the indigenous surviving red squirrels of Speyside can still be identified by a paler tail.

The reintroductions were only too successful. By 1900 red squirrels had reoccupied the Highlands and most of the Lowlands. They became universally regarded as a pest, and squirrel clubs were formed to keep the numbers down. The great naturalist James Ritchie in 1920 regarded the reintroduction of the red squirrel to have been an act of unconsidered folly, and the forester M. L. Anderson (1967) talked of the 'disastrous invasion' of the red squirrel, saying that 60,000 had been killed in 16 years by the Highland squirrel clubs, but without reducing the threat to Scottish forestry.

Meanwhile, 'some lunatic', in Professor Anderson's words, introduced a pair of grey squirrels to Loch Long about 1890, other owners introduced it into Fife, then into the Zoological Park in Edinburgh, and more recently they have also made their own way over the border from the burgeoning introduced populations in England. In most places where they advance, the red squirrel falls back, unable to compete, and threatened by a disease that the grey carries but from which it does not die.

Within two decades after the 1960s the red squirrel had swapped its old status as a reintroduced pest, for its present one of a charismatic native animal threatened by an alien. The Forestry Commission,



which had once supported the extirpation of the red squirrel, now supported clubs to kill the grey squirrel and discouraged the plantation of hardwoods in areas where doing so might encourage the grey squirrel and threaten the red. The ironies of history can be wonderful.

A relatively high percentage of land mammals in Britain are classified as aliens (21 out of 49 established species), but the overwhelming majority of British birds are classed as native. Wings meant that the flooding of the North Sea land bridge presented little problem for most of them.

On the other hand there are some very visible alien species among the birds—most notably pheasant, red-legged partridge, ruddy duck, mandarin duck, and Canada goose. Some populations of these originated from escapes or releases from private collections in England, spreading of their own accord across the border: others were introduced by noblemen for sport or ornament, the oldest, the pheasant, being first found in Scotland in the late sixteenth century.

A great fuss has been made about the American ruddy duck, which is heading for official extirpation in Britain, because of the threat of it flying off to Spain and interbreeding there with the native white-headed duck, and producing genetically confusing hybrids. By contrast, remarkably little fuss has ever been made about the ecological impact of the equally alien pheasant. A recent article in *British Birds* (Musgrove, 2013) indicated that some 30 million are released annually, and as 30-40% of their food for much of the year is insects, research would seem timely. I know of a population of dingy skippers, a scarce butterfly on Speyside, that disappeared after pheasant rearing pens were located in the vicinity.

Most native bird species breed in wild places that we readily identify as natural habitat, like dotterel on the mountain tops and gannets and puffins on offshore islands. Yet a number have such dependency on man-made places that their presence in Scotland is hard to imagine in the absence of people. But they are considered as natives too, sometimes described as commensals. Some are migrants like the swallow and the swift that come and go completely independent of man, but where would they nest if there were no buildings? Others may actually have hitched a lift with people, as they are reluctant migrants, but because they occupy adjacent continental Europe they are presumed to have crossed the water by themselves. We assume that the house sparrow came of its own accord, but it might have come as a pet of neolithic man, and the corn bunting does not normally move very far and is not likely to be able to exist without agriculture. On the other hand,

ringing returns do indicate that both species are actually capable of their own accord of flying the distance over the English Channel or the Minch, albeit infrequently. These particular commensal species probably all came in prehistory, but as late as the twentieth century we gained other species that are also entirely dependent on our activities. The collared dove completed an expansion north-west across Europe that had begun early in the century, by nesting in a farm garden in Moray in 1957, and has remained devoted to villages, gardens and farms ever since. The little ringed plover in southern Europe depended on bare areas of sand and gravel, expanded north taking advantage of the quarries of the construction industry, and arrived in Scotland in 1968 to nest on waste ground when the motorways were being built. It has since settled down to become a regular denizen of the gravel pits of Fife and elsewhere.

One set of native Scottish birds that are certainly not commensals but nevertheless arrived as breeding birds only recently, are most of the ducks. As late as 1800, only four species nested – mallard, teal, shelduck and eider, and possibly the common scoter. In the nineteenth century another six arrived – wigeon, pintail, tufted duck, pochard, goosander and red-breasted merganser. All of these continued to spread their range within Scotland in the twentieth century when they were joined by another three-- gadwall, goldeneye and garganey. (Forrester and Andrews, 2007). Why this should be is obscure, and seems to have had nothing to do with man, except that the goldeneye is almost entirely dependent on nest boxes. Perhaps it represents the last stage of a natural expansion of waterfowl out of Asia following the last ice age.

The mobility of birds is of course not normally shared by flowering plants. Forty-seven percent of the established taxa in the *New Atlas of British and Irish Flora* of 2002 are defined as aliens (Preston et al, 2002). Some were just a bit unlucky. The Norway spruce was naturally present in previous interglacials and is native to nearby Scandinavia, but this time never made it back west soon enough across the North Sea land bridge. Perhaps because its natural range in Europe is close and at a similar latitude to Scotland, when it was introduced for forestry it proved peculiarly hospitable to our native insects and birds. But the same does not apply to *Rhododendron ponticum*, another species present during a previous interglacial, but in this case introduced to ornamental parks and policies from more distant Spain. It has become a classic alien menace to natural eco-systems in Scotland, particularly invasive in the native oak-woods of the west. But it is worth remembering that not all invasive species are aliens; bracken is a native species, and if you go to Mull it is an open question whether you will be more alarmed by the recent



spread of *R. ponticum*, or the recent spread of bracken on moors where sheep grazing pressure has lightened. Certainly both tend to alter or obliterate what was there before.

Botanists are perhaps more sophisticated people than other folk, and have made a distinction between archaeophytes, introduced before around 1500, with the discovery of America and the first voyages to India, and neophytes, introduced later. The distinction separates out the plants that have come from other continents as a result of Empire and modern globalisation. The neophytes, far the most numerous as well as the more recent, include the unpopular Japanese knotweed, Himalayan balsam and giant hogweed, all escapes from cultivation after being introduced from Asia, and now considered pests. Nine of the top ten most rapidly increasing plant species in Britain are neophytes, eight of which were originally garden plants that got loose. The archaeophytes are a much smaller group, (5% of British flora are archaeophytes as compared to 42% which are neophytes). They are also much less successful: out of the 100 species showing the most rapid relative decline in Britain, 39 are archaeophytes. Eight out of ten of the most rapidly declining plant species in Britain are ancient weeds of arable fields that possibly came in with the Neolithic farmers, with resonant names like Good King Henry, Venus's looking glass and corn marigold (known in Gaelic as rot-the-corn). Interestingly, many are now protected, the Joint Nature Conservation Committee justifying protecting these aliens because they are at risk over much of their European range and of 'considerable historical and cultural interest'. (Cheffings and Farrell, 2005) This may be the first time that historical interest, as distinct from scientific interest, has become an explicit reason for over-ruling the native/alien divide in nature conservation.

I have not left myself much time to discuss other important groups, like insects, fungi or fish. Insects, or rather the most nimble flyers among them, like bumble bees, butterflies, dragonflies and hoverflies, have few alien species among them, though several are recent natural arrivals through anthropogenic global warming, like *Bombus hypnorum* among the bees and small red-eyed damselflies among the odonata. Few of these have yet reached Scotland, though our butterfly biodiversity has recently been enriched by long-established southern native butterflies like comma and large skipper that have invaded Scotland from England without other human help. Less mobile insects, like aphids and beetles, are more likely to provide alien species, as they come ashore in containers or on imported plants; unfortunate examples are the lupin aphid that arrived from America in 1981 and now reduces garden lupins to pulp in a matter of days, and the

harlequin ladybird, which arrived in Britain in 2004 and has also spread to Scotland. It is a threat to the 46 other, native, species of British ladybirds: let us hope it also eats the lupin aphids.

Fungi one might expect to have few aliens, as their spores should make them naturally mobile over great distances. Yet because the prevailing winds are from the south-west, those to the east that did not make it over the North Sea in Mesolithic times apparently find it hard to invade today. Andrew Taylor (2013) has recently shown how we have about 130 species of fungi of the genus *Cortinarius*; but this group is much better represented in Scandinavia, where there are 900 species, many of them associated with spruce forests. Because Norway spruce failed to make it over the North Sea, our *Cortinarius* fungi list is relatively short, and the west wind apparently stops them coming over to colonise our modern Sitka and Norway spruce forests which should be suitable for them.

Yet some of the biggest menaces to forests today are alien pathogens, fungus-like oomycetes, believed to have come from overseas in consignments of rooted horticultural plants, notably *Phytophthora ramorum* and other of the same genus, which in Europe infect rhododendron (including the invasive *R. ponticum*) and Japanese larch, and show signs of affecting even native bilberry and possibly heather as well. The danger of *Phytophthora austrocedrae* to the beautiful junipers of the Caledonian pinewood in Speyside has attracted remarkably little attention so far. Much better publicised is *Chalara fraxiniae*, ash dieback, a pathogen of Far Eastern origin which first appeared in Poland in 1991. In so far as it is associated with imported plants, it is an alien species; but the concentration of cases in Kent and East Anglia suggests that in this case it also arrived by air on a short sea crossing, either wind born or bird born, in which case should it strictly speaking also be classified as a native? These infections pose the biggest threat to British woodland ecosystems imaginable, and appear to be unstoppable.

I am not even going to attempt to deal with the species of the rivers and seas, as I have no time, except to mention that they too contain some really unwelcome invasive alien species, like the signal crayfish from America which is a threat to a range of biodiversity in our rivers, possibly including native pearl mussels, and Japanese wireweed, which out-competes native seaweeds. Some pests have come in association with aquaculture, others with shipping, either on the bottoms or in the bilge water.

## SUMMARY

We are a species too, inescapably part of nature, just one of millions that have evolved. We have

categorised other species as either native or alien, and these categories are determined for some species by historic accident (whether or not they were able to cross by the land bridge), for others by their natural mobility (whether they could fly or float across the sea). Globalisation or trade, has been the main driver for adding alien species to our biodiversity, and though this has operated since Neolithic times (think of the Orkney vole), it began to accelerate after the discovery by Europeans of a direct route to Asia and the Americas soon before 1500, and has enormously increased in the past century. Alien species are defined as being brought into the country by human agency, but this is not to be confused with dependence on people: some native species have evolved towards almost total dependence on people (swallow or house sparrow), while many alien species, once they arrived, have little or no further contact or dependency on people – indeed it is their invasiveness in the natural world that causes most of the problem (signal crayfish in our waters) While most aliens are relatively new arrivals, others have been here for thousands of years, like the house mouse, the rabbit or the archaeophyte weeds of cultivation. Some of these have formed habitats around themselves, and there are serious ecological consequences when these are disturbed, as when one alien species (myxomatosis) devastated another (rabbits) and heathlands became scrubbed over.

Alien species are not to be unthinkingly equated with harmfulness, nor native species with being benign: some invasive species are native (like bracken and wood-pigeons) and many alien species live here doing no harm to anyone. But undeniably some alien species do have the capacity to become immensely destructive, and it is hard to tell which in advance. The deliberate release of non-native species into the wild is therefore wrong, as is the release of native species like hedgehogs onto islands where they have never occurred before and where they are locally aliens. Some species -- to use an old but valid word -- are pests. Dealing with species as pests is entirely reasonable, but what is needed is not dogma about native and aliens, but a sense of proportion and common sense.

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